Tissue Engineering the Small Intestine.

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Public Summary:
Short bowel syndrome (SBS) results from the loss of a highly specialized organ, the small intestine. SBS and its current treatments are associated with high morbidity and mortality. Production of tissue-engineered small intestine (TESI) from the patient's own cells could restore normal intestinal function via autologous transplantation. Improved understanding of intestinal stem cells and their niche have been coupled with advances in tissue engineering techniques. Originally described by Vacanti et al of Massachusetts General Hospital, TESI has been produced by in vivo implantation of organoid units. Organoid units are multicellular clusters of epithelium and mesenchyme that may be harvested from native intestine. These clusters are loaded onto a scaffold and implanted into the host omentum. The scaffold provides physical support that permits angiogenesis and vasculogenesis of the developing tissue. After a period of 4 weeks, histologic analyses confirm the similarity of TESI to native intestine. TESI contains a differentiated epithelium, mesenchyme, blood vessels, muscle, and nerve components. To date, similar experiments have proved successful in rat, mouse, and pig models. Additional experiments have shown clinical improvement and rescue of SBS rats after implantation of TESI. In comparison with the group that underwent massive enterectomy alone, rats that had surgical anastomosis of TESI to their shortened intestine showed improvement in postoperative weight gain and serum B12 values. Recently, organoid units have been harvested from human intestinal samples and successfully grown into TESI by using an immunodeficient mouse host. Current TESI production yields approximately 3 times the number of cells initially implanted, but improvements in the scaffold and blood supply are being developed in efforts to increase TESI size. Exciting new techniques in stem cell biology and directed cellular differentiation may generate additional sources of autologous intestinal tissue for direct translation to human therapy.

Scientific Abstract:
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